Version 6.3

Montana Department of

ENVIRONMENTAL QUALITY

DEPARTMENT CIRCULAR

DEQ-12, PARTS A and B

Montana Base Numeric Nutrient Standards and Nutrient Standards Variances

GENERAL INTRODUCTION

This circular contains information pertaining to the base numeric nutrients standards (§75-5-103[2], MCA) and their implementation. It is divided into **Parts A** and **B**. **Part A** contains the water quality standards including concentration limits, where they apply, and their period of application. **Part A** is adopted by the Board of Environmental Review under its rulemaking authority in §75-5-301(2), MCA.

Part B contains information about variances from the base numeric nutrient standards. This includes effluent treatment requirements associated with general nutrient standards variances, as well as effluent treatment requirements for individual nutrient standards variances and to whom these apply. **Part B** also contains the Department's definition of the total nitrogen (TN) and total phosphorus (TP) concentrations achievable at the limits of technology. Unlike **Part A**, **Part B** is not adopted by the Board of Environmental Review; **Part B** is adopted by the Department following its formal rule making process, pursuant to §75-5-313, MCA.

The Department has reviewed a considerable amount of scientific literature and has carried out scientific research on its own in order to derive the base numeric nutrient standards (see **References** in **Part A**). Because many of the base numeric nutrient standards are stringent and may be difficult for MPDES permit holders to meet in the short term, Montana's legislature adopted laws (e.g., §75-5-313, MCA) allowing for the achievement of the standards over time via the variance procedures in **Part B**. This approach should allow time for nitrogen and phosphorus removal technologies to improve and become less costly, and to allow time for nonpoint sources of nitrogen and phosphorus pollution to be better addressed.

Circular DEQ-12, PART A

SEPTEMBER 2012 EDITION

1.0 Introduction

Elements comprising Circular DEQ-12, **Part A** are found below. These elements are adopted by the Montana Board of Environmental Review. The nitrogen and phosphorus concentrations provided here have been set at levels that will protect beneficial uses, and prevent exceedences of other surface water quality standards which are commonly linked to nitrogen and phosphorus concentrations (e.g., dissolved oxygen; see Circular DEQ-7 for the dissolved oxygen standards). The nitrogen and phosphorus concentrations also reflect the intent of the narrative standard at ARM 17.30.637(1)(e), and will preclude the need for case-by-case interpretations of that narrative standard.

1.1 Definitions

1. **Ecoregion** means mapped regions of relative homogeneity in ecological systems, derived from perceived patterns of a combination of causal and integrative factors including land use, land surface form, potential natural vegetation, soils, and geology. See also, endnote 1.

2. **Large river** means a perennial waterbody which has, during summer and fall baseflow (August 1 to October 31 each year), a wadeability index (product of river depth [in feet] and mean velocity [in ft/sec]) of 7.24 ft^2/sec or greater, a depth of 3.15 ft or greater, or a baseflow annual discharge of 1,500 ft^3/sec or greater. See also, endnote 5.

3. **Total nitrogen** means the sum of all nitrate, nitrite, ammonia, and organic nitrogen, as N, in an unfiltered water sample. Total nitrogen in a sample may also be determined via persulfate digestion, or as the sum of total kjeldahl nitrogen plus nitrate plus nitrite.

4. **Total phosphorus** means the sum of orthophosphates, polyphosphates, and organically bound phosphates, as P, in an unfiltered water sample. Total phosphorus may also be determined directly by persulfate digestion.

5. **Wadeable stream** means a perennial or intermittent stream in which most of the wetted channel is safely wadeable by a person during baseflow conditions.

2.0 Base Numeric Nutrient Standards

Table 12A-1 below shows the base numeric nutrient standards for Montana's wadeable streams and large rivers. Details on how these standards were derived can be found mainly in Addendum 1 of Suplee et al. (2008). In **Table 12A-1** nutrient standards for wadeable streams are sub-grouped by ecoregion, either at level III (coarse scale) or level IV (fine scale). Following the ecoregional standards is a list of wadeable streams with reach-specific standards; these waterbodies have characteristics disimilar from those of the ecoregions in which they reside and have therefore been provided reach-specific values. **For the wadeable streams, the standards should be applied in this order: reach specific (if applicable) <u>then</u> level IV ecoregion (if applicable) <u>then</u> level III ecoregion. Table 12A-1** also contains a list of large river segments for which base numeric nutrient standards have been developed.

Table 12A-2 is a placeholder table for base numeric nutrient standards that may be adopted for Montana's lakes and reservoirs.

Table 12A-1. Base Numeric Nutrient Standards for Wadeable Streams in Different Montana Ecoregions, and Base Numeric Nutrient Standards for Individual Wadeable-stream and Large-river Reaches. Related assessment information is also shown.

		Numeric Nutrient Standard[3]		
Ecoregion[1,2] (level III or IV) and Number, or Individual Reach Description	**Period When Criteria Apply**	**Total Phosphorus (µg/L)**	**Total Nitrogen (µg/L)**	**Related Assessment Information[4]**
ECOREGION (level III or IV):				
Northern Rockies (15)	July 1 to September 30	30	300	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Canadian Rockies (41)	July 1 to September 30	25	350	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Idaho Batholith (16)	July 1 to September 30	30	300	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Middle Rockies (17)	July 1 to September 30	30	300	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Absaroka-Gallatin Volcanic Mountains (17i)	July 1 to September 30	105	250	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Northwestern Glaciated Plains (42)	June 16 to September 30	110	1400	
Sweetgrass Upland (42l), Milk River Pothole Upland (42n), Rocky Mountain Front Foothill Potholes (42q), and Foothill Grassland (42r)	July 1 to September 30	80	560	165 mg Chl*a* /m^2 and 70 g AFDM/m^2
Northwestern Great Plains (43) and Wyoming Basin (18)	July 1 to September 30	140	1400	
River Breaks (43c)	NONE RECOMMENDED	NONE RECOMMENDED	NONE RECOMMENDED	
*Non-calcareous Foothill Grassland (43s), Shields-Smith Valleys (43t), Limy Foothill Grassland (43u), Pryor-Bighorn Foothills (43v), and Unglaciated Montana High Plains (43o)**	July 1 to September 30	33	440	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
INDIVIDUAL REACHES (Wadeable Streams):				
Flint Creek, from Georgetown Lake outlet to the ecoregion 17ak boundary (46.4002, -113.3055)	July 1 to September 30	72	500	150 mg Chl*a* /m^2 and 45 g AFDM/m^2
Bozeman Creek, from headwaters to Forest Service Boundary (45.5833, -111.0184)	July 1 to September 30	105	250	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Bozeman Creek, from Forest Service Boundary (45.5833, -111.0184) to mouth at East Gallatin River	July 1 to September 30	76	270	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Hyalite Creek, from headwaters to Forest Service Boundary (45.5833,-111.0835)	July 1 to September 30	105	250	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Hyalalite Creek, from Forest Service Boundary (45.5833,-111.0835) to mouth at East Gallatin River	July 1 to September 30	90	260	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
East Gallatin River between Bozeman Creek and Bridger Creek confluences	July 1 to September 30	50	290	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
East Gallatin River between Bridger Creek and Hyalite Creek confluences	July 1 to September 30	30	300	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
East Gallatin River from Hyalite Creek confluence to the mouth (Gallatin River)	July 1 to September 30	60	290	125 mg Chl*a* /m^2 and 35 g AFDM/m^2
Clark Fork River from below the Warm Springs Creek confluence (46.1881, -112.7680) to the Bitterroot River confluence	July 1 to September 30	20	300	100 mg Chl*a* /m^2 (summer mean); 150 mg Chl*a* /m^2 (summer maximum)
INDIVIDUAL REACHES (Large Rivers[5]):				
Clark Fork River from the Bitterroot River confluence to the Flathead River confluence	July 1 to September 30	24	300	100 mg Chl*a* /m^2 (summer mean); 150 mg Chl*a* /m^2 (summer maximum)
Yellowstone River (Bighorn River confluence to Powder River confluence)	August 1 -October 31	90	700	
Yellowstone River (Powder River confluence to stateline)	August 1 -October 31	140	1000	

*For the Unglaciated High Plains ecoregion (43o), criteria only apply to the polygon located just south of Great Falls, MT.

[1] See endnote 1

[2] See endnote 2

[3] See endnote 3

[4] See endnote 4

[5] See endnote 5

12A-2. Table of Base Numeric Nutrient Standards for Lakes and Reservoirs that May be Adopted.

Ecoregion[1] (level III or IV) and Number, or Individual Lake or Reservoir Description	Period of Application	Numeric Nutrient Standard[6] Total P (µg/L)	Total N (µg/L)	Related Assessment Information
LAKES/RESERVOIRS by ecoregion:				
Middle Rockies (17)	Year-round	[]	[]	Phytoplankton [] µg Chl*a* /l and Secchi depth [] m
Northern Rockies (15)	Year-round	[]	[]	Phytoplankton [] µg Chl*a* /l and Secchi depth [] m
Canadian Rockies (41)	Year-round	[]	[]	Phytoplankton [] µg Chl*a* /l and Secchi depth [] m
Idaho Batholith (16)	Year-round	[]	[]	Phytoplankton [] µg Chl*a* /l and Secchi depth [] m
LAKE SPECIFIC CRITERIA:				
	Year-round	[]	[]	Phytoplankton [] µg Chl*a* /l and Secchi depth [] m
RESERVOIR SPECIFIC CRITERIA:				
	Year-round	[]	[]	Phytoplankton [] µg Chl*a* /l and Secchi depth [] m

[1] See endnote 1

[6] See endnote 6

2.1 Required Reporting Values for Base Numeric Nutrient Standards

Table 12A-3 presents the required reporting values for total phosphorus and total nitrogen measurements used to conform with the base numeric nutrient standards in this circular.

Table 12A-3. Required reporting values[a,b] for total nitrogen and phosphorus measurements.

Nutrient		Method of Measurement	Required Reporting Value
Total phosphorus		Persulfate digestion	3 µg/L
Total nitrogen		Persulfate digestion	70 µg/L
Total nitrogen	Sum of:	(a) total kjeldahl nitrogen	150 µg/L
		(b) nitrate + nitrite	See RRVs below
Nitrate- as N			20 µg/L
Nitrite- as N			10 µg/L
Nitrate + Nitrite-as N			20 µg/L

[a] See definition for required reporting values found in footnote 19 of Department Circular DEQ-7.

[b] Concentrations in Table 12A-3 must be achieved unless otherwise specified in a permit, approval, or authorization issued by the Department (DEQ-7; ARM 17.30.702).

2.2 Developing Permit Limits for Base Numeric Nutrient Standards

For total nitrogen and total phosphorus, the critical low-flow for the design of disposal systems shall be based on the seasonal 14Q5 of the receiving water (see ARM 17.30.635[4]). When developing permit limits for base numeric nutrient standards, the Department will use an average monthly limit (AML) only, using methods appropriate for criterion continuous concentrations (i.e., chronic concentrations). Permit limits will be established using a value corresponding to the 95th percentile probability distribution of the effluent. The Department shall use methods that are appropriate for criterion continuous concentrations which are found in the document "*Technical Support Document for Water Quality-based Toxics Control*", Document No. EPA/505/2-90-001, United States Environmental Protection Agency, 1991.

3.0 Endnotes

(1) Ecoregions are based on the 2009 version (version 2) of the U.S. Environmental Protection Agency maps. These can be found at: http://www.epa.gov/wed/pages/ecoregions/mt_eco.htm . For Geographic Information System (GIS) use within DEQ, the GIS layers may be found at: L:\DEQ\Layers\Ecoregions.lyr

(2) Within and among the geographic regions or watersheds listed, base numeric nutrient standards of the downstream reaches, or other downstream waterbodies, must continue to be maintained.

(3) The 30 day (monthly) average concentration of these parameters may not be exceeded more than once in any five year period, on average.

(4) Related assessment information comprises water quality variables affected by nitrogen and phosphorus concentrations and includes parameters such as dissolved oxygen, pH, and algal density. Values shown refer to bottom-attached (benthic) algae density quantified as chlorophyll *a* (Chl*a*) or ash free dry mass (AFDM) per square meter of stream bottom. The values are the arithmetic mean of ≥10 replicate measures of benthic algae collected in the wadeable zone (water depths ≤ 1m) from a site during a sampling event. A site is a reach of a stream ≥100 m long but <500 m long or, for some larger streams and for large rivers, may be a transect perpendicular to flow. Algae replicates must be collected in the wadeable zone of streams and rivers using a randomized approach or other, unbiased systematic approaches. Chl*a* and AFDM are used to assess the biomass of algae accumulated on the stream bottom; algae is stimulated by excess nitrogen and phosphorus levels and is associated with (for example) impacts to recreational uses and impacts to stream dissolved oxygen levels.

For the Clark Fork River, the maximum summer algae value is the single greatest of any of the monthly mean Chl*a* values at a given site. Therefore, there is only one month each summer representing the maximum. The summer mean is the arithmetic mean of the set of all benthic algae replicates collected at a site during a given summer.

(5) **Table E-4** below shows the beginning and ending locations for large rivers in Montana.

Table E-4. Large river segments within the state of Montana.

River Name	Segment Description
Big Horn River	Yellowtail Dam to mouth
Clark Fork River	Bitterroot River to state-line
Flathead River	Origin to mouth
Kootenai River	Libby Dam to state-line
Madison River	Ennis Lake to mouth
Missouri River	Origin to state-line
South Fork Flathead River	Hungry Horse Dam to mouth
Yellowstone River	State-line to state-line

(6) No lake or reservoir referenced in **Table12A-2** shall have an average concentration that exceeds the values shown based upon a monthly (30-day) period. The Department will determine on a case-by-case basis whether or not a permitted discharge to a stream or river is likely to be impacting a downstream lake or reservoir. If yes, the permittee would be expected to meet its average monthly limit year round.

4.0 References

The following are citations for key scientific and technical literature used to derive the base numeric nutrient standards. This is not a complete list; rather, it contains the most pertinent citations. Many other articles and reports were reviewed during the development of the standards.

Biggs, B.J.F., 2000. New Zealand Periphyton Guideline: Detecting, Monitoring and Managing Enrichment in Streams. Prepared for the New Zealand Ministry of the Environment, Christchurch, 122 p.

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Suplee, M.W., V. Watson, A. Varghese, and J. Cleland, 2008. Scientific and Technical Basis of the Numeric Nutrient Criteria for Montana's Wadeable Streams and Rivers, ***and Addendums***. Helena, MT: Montana Department of Environmental Quality, 86 p.

Suplee, M.W., V. Watson, M. Teply, and H. McKee, 2009. How Green is too Green? Public Opinion of what Constitutes Undesirable Algae Levels in Streams. Journal of the American Water Resources Association 45: 123-140.

Suplee, M.W., and R. Sada de Suplee, 2011. Assessment Methodology for Determining Wadeable Stream Impairment Due to Excess Nitrogen and Phosphorus Levels. Helena, MT: Montana Department of Environmental Quality

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Woods, A.J., J.M. Omernik, J.A. Nesser, J. Shelden, J.A. Comstock, and S. J. Azevedo, 2002. Ecoregions of Montana, 2nd edition. (Color Poster with Map, Descriptive Text, Summary Tables, and Photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

Circular DEQ-12, PART B

SEPTEMBER 2012 EDITION

1.0 Introduction

Elements comprising Circular DEQ-12**, Part B** are found below. These elements are adopted by the Department following the Department's formal rule making process. Montana state law (§75-5-103 [22], MCA and 75-5-313, MCA) allows for variances from the base numeric nutrient standards (found in **Part A** of this circular) based on a determination that base numeric nutrient standards cannot be achieved because of economic impacts or because of the limits of technology.

1.1 Definitions

1. **Limits of technology** means wastewater treatment processes for the removal of nitrogen and phosphorus compounds from wastewater that can consistently achieve a concentration of 70 µg TP/L and 4,000 µg TN/L.

2. **Long-term average** means a description of effluent data from a treatment system using standard descriptive statistics and an assumption that the data follow a lognormal distribution. See also, "*Technical Support Document for Water Quality-based Toxics Control*", Document No. EPA/505/2-90-001, United States Environmental Protection Agency, 1991.

2.0 General Nutrient Standards Variances

Because the treatment of wastewater to base numeric nutrient standards in 2011 would have resulted in substantial and widespread economic impacts on a statewide basis (§75-5 -313 [5][a], MCA), a permittee who meets the end-of-pipe treatment requirements provided below in **Table 12B-1** may apply for and may be granted a general nutrient standards variance ("general variance")(§75-5 -313 [5][b], MCA). A person may apply for a general variance for either total phosphorus or total nitrogen, or both. The general variance may be established for a period not to exceed 20 years. A compliance schedule to meet the treatment requirements shown in **Table 12B-1** may be granted on a case-by-case basis.

Cases will arise in which a permittee is or will be discharging effluent with N and/or P concentrations lower than (i.e., better than) the minimum requirements of a general variance. And yet, the resulting concentrations outside of the mixing zone still exceed the base numeric nutrient standards. Such discharges are still within the scope of the general variance, because statute indicates that a general variance is allowable if the permittee treats the discharge to, **at a minimum**, the concentrations indicated by §75-5-313(5)(b)(i)and (ii), MCA. Thus, permitted discharges better than those at §75-5-313(5)(b)(i)and (ii), MCA are not precluded from falling under a general variance.

Table 12B-1. General variance end-of-pipe treatment requirements per §MCA 75-5 -313(5)(b), through May 2016.

	Long-term Average	
Discharger Category[1]	Total P (µg/L)	Total N (µg/L)
≥ 1.0 million gallons per day	1,000	10,000
< 1.0 million gallons per day	2,000	15,000
Lagoons not designed to actively remove nutrients	Maintain current performance	Maintain current performance

[1] See endnote 1

The Department must review the general variance treatment requirements every 3 years to assure that the justification for their adoption remains valid. The purpose of the review is to determine whether there is new information that supports modifying (e.g., revising the interim effluent treatment requirements) or deleting the variance. If a low-cost technological innovation for lowering nitrogen and phosphorus concentrations in effluent were to be developed in the near future, for example, the Department could (after May 2016) make more stringent the concentrations shown in the table. If the Department were to adopt general variance treatment requirements more stringent than those provided in **Table 12B-1**, revised effluent limits will be included with the permit during the next permit cycle, unless the demonstration discussed in **Section 2.2** below is made. A compliance schedule may also be granted to provide time to achieve compliance with revised effluent limits.

Only after changes in specified factors have occurred would the general variance treatment requirements be made more stringent. The review will occur triennially and will be carried out at a fairly coarse level (i.e., statewide). The Department and the Nutrient Work Group will consider various factors such as:

1. Whether more cost-effective, efficient, and innovative nutrient removal technologies are available.

2. Whether Montana's economic status had changed sufficiently to make nutrient removal more affordable. If new technologies (per 1 above) have not become widely available, the Department will estimate on a statewide basis the cost for facilities within a category (per §75-5-313(5)(b)(i) and (ii), MCA) to move to the next more stringent nutrient treatment level . Different levels of nutrient removal and achievability are defined in Falk et al. (2011)[1].

[1] See Endnote 2.

3. Whether development of permit limits for base numeric nutrient standards should be revised to reflect N- or P-compound speciation and bioavailability.

2.1 Wastewater Facility Optimization Study

Permitees receiving a general variance are required to evaluate current facility operations to optimize nutrient reduction with existing infrastructure and shall analyze cost-effective methods of reducing nutrient loading, including but not limited to nutrient trading without substantial investment in new infrastructure (§75-5-313[9][a], MCA). The Department encourages permittees to examine a full array of reasonable options including (but not limited to) reuse, recharge, and land application. The Department may request the results of the optimization/nutrient reduction analysis within two years of granting a general variance to a permittee.

Changes to facility operations resulting from the analysis carried out per the above paragraph are only intended to be refinements to the system already in place. Therefore, optimizations:

1. Should only address changes to facility operation and maintenance and should not be structural changes
2. Should not result in rate increases
3. Must include exploration of the feasibility of nutrient trading within the watershed

Who and how the analysis is carried out can be decided by the permittee. The Department encourages the use of a third-party firm with expertise in this subject.

2.2 Option for Remaining at a Previous General Variance Long-term Average

In some cases, upgrading a wastewater facility to a more stringent general variance concentration adopted by the department may not result in a net environmental benefit in the receiving waterbody or material progress towards attaining the standard, and would result in more environmental harm than remaining at the previous general-variance concentration. If such a case can be demonstrated to the satisfaction of the Department, then a permittee will not be required at that time to upgrade the wastewater facility to meet the new general variance concentration (ARM 17.30.XXX). The permittee will, however, be required to provide monitoring water-quality data that can be used to determine if the justifications for forgoing the upgrade continue to hold true. Details on the requirements for making the demonstration and for collecting the monitoring data are provided in the Department guidance document "*Carrying out a Substantial and Widespread Economic Analysis for Individual Nutrient Standards Variances* AND *Guidelines for Determining if a Waste Water Treatment Facility Can Remain at a Previous General Variance Concentration*".

3.0 Individual Nutrient Standards Variances

Montana law allows for the granting of nutrient standards variances based on the particular economic and financial conditions of a permittee (§75-5-313 [1], MCA). Individual nutrient standards variances ("individual variances") may be granted on a case-by-case basis because the attainment of the base numeric nutrient standards is precluded due to economic impacts, limits of technology, or both. In general, individual variances are intended for permittees who would have financial difficulties meeting even the general variance concentrations, and are seeking individual N and P permit limits tailored to their specific economic situation.

Unlike the general variances presented in **Section 2.0** above, individual variances may only be granted to a permittee after the permittee has made a demonstration to the Department of economic impacts, the limits of technology, or both (ARM 17.30XXX). The Department, in conjunction with the Nutrient Work Group, has developed as assessment process that must be completed by applicants seeking an individual variance. The assessment process is found in the Department guidance document "*Carrying out a Substantial and Widespread Economic Analysis for Individual Nutrient Standards Variances* AND *Guidelines for Determining if a Waste Water Treatment Facility Can Remain at a Previous General Variance Concentration"*.

A permittee, using the assessment process referred to above, must also demonstrate to the Department that there are no reasonable alternatives (including but not limited to trading, compliance schedules, reuse, recharge, and land application) that would allow compliance with the base numeric nutrient standards. If no reasonable alternatives exist, then an individual variance is justifiable and becomes effective and may be incorporated into a permit following the Department's formal rule making process. Individual variances the Department may adopt in the future will be documented in **Table 12B-2** below.

Like general variances, the basis and justification for individual variances must be reviewed by the department every three years as part of the water quality standards triennial review. For most individual variances, the basis will be the economic status of the community, i.e., the demonstration of substantial and widespread economic impacts. At the triennial review the Department will consider if the basic economic status of a community granted an individual variance has changed. The same parameters used to justify the original individual variance will be considered; these are detailed in the guidance document "*Carrying out a Substantial and Widespread Economic Analysis for Individual Nutrient Standards Variances* AND *Guidelines for Determining if a Waste Water Treatment Facility Can Remain at a Previous General Variance Concentration"*. If new, low-cost nutrient removal technologies have become widely available, or if the economic status of the community has sharply improved, the basis of the variance may no longer be justified. In such cases the department will discuss with the permittee the options going forward, including but not limited to a permit compliance schedule, trading, reuse, recharge, land application, or a general variance.

Table 12B-2. Table for individual variances that may be adopted.

MPDES Number	Facility Name	Discharge Latitude	Discharge Longitude	Receiving Waterbody	Receiving Waterbody Classification	Long-term Average Total P (µg/L)	Long-term Average Total N (µg/L)	Start Date	Sunset Date (maximum)	Review Schedule (year)	Review Outcome

4.0 Endnotes

(1) Based on facility design flow.

(2) Falk, M.W., J.B. Neethling, and D.J. Reardon, 2011. Striking a Balance between Wastewater Treatment Nutrient Removal and Sustainability. Water Environment Research Foundation, document NUTR1R06n, IWA Publishing, London, UK.